भारतीय मानक
Indian Standard

IS 6590 : 2023

पर्वतारोहण के लिए रस्सियाँ — विशिष्टि

(पहला पुनरीक्षण)

Ropes for Mountaineering — Specifications

(First Revision)

ICS 13.340.60; 59.080.50; 97.220.40

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुरशाह ज़फर मार्ग, नई दिल्ली – 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI-110002
www.bis.gov.in www.standardsbis.in

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FOREWORD

This Indian Standard (First Revision) has been adopted by the Bureau of Indian Standards after the draft is finalized by the Mountaineering and Adventure Sports Sectional Committee had been approved by the Production and General Engineering Division Council.

This standard covers ropes used for rope access in mountaineering applications. Over the past few decades similar applications have been developed for industrial jobs, where the user uses rope access techniques to reach inaccessible areas for example window cleaning or painting of high-rise buildings, maintenance of chimneys, cleaning of windmill blades etc. This standard has been upgraded and both semi-static and dynamic ropes have been covered to account for both mountaineering and industrial applications.

This standard was originally published in 1972 by the Cordage sectional committee TDC 14. Subsequently, it was transferred to Mountaineering and Adventure Sports Sectional Committee. The first revision of this standard has been undertaken to align it with the latest national and international manufacturing practices.

The major changes in this revision are as follows:

a) normative references (**2**) are updated;
b) new types of ropes have been added;
c) designation system for ropes has been introduced; and
d) test methods have been updated.

In the preparation of this standard, considerable assistance has been derived from the following standards:

EN 892 : 2012 + A1 : 2016	Mountaineering equipment — Dynamic mountaineering ropes — Safety requirements and test methods
UIAA 101 : 2019	Dynamic Ropes

The composition of the Committee, responsible for the formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Indian Standard

ROPES FOR MOUNTAINEERING — SPECIFICATIONS

(First Revision)

1 SCOPE

1.1 This standard prescribes requirements for braided rope used generally as climbing ropes for mountaineering or other high-altitude operations, industrial rope access applications and rescue during disaster management.

1.2 The standards cover both semi static and dynamic ropes.

2 REFERENCES

2.1 The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
3256 : 1980	Code for inland packaging of ropes and cordages (*first revision*)
3521 (Part 2) : 2021	Personal fall arrest systems — Specification: Part 2 Lanyards and energy absorbers
3521 (Part 6) : 2021	Personal fall arrest systems: Part 6 System performance tests
3871 : 2013	Fibre ropes and cordage — Vocabulary (*third revision*)
7071 : 2021	Fibre ropes — Determination of certain physical and mechanical properties (*second revision*)
8533 : 1977	General purpose carabiners for mountaineering

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 3871 as well as the following shall apply:

3.1 Type of Ropes

3.1.1 *Dynamic Rope* — Rope specifically designed to absorb energy in a fall by stretching, thereby minimizing the impact force.

3.1.2 *Dynamic Mountaineering Rope* — Rope, which is capable, when used as a component in the safety chain, of arresting the free fall of a person engaged in mountaineering or climbing with a limited peak force.

3.1.3 *Climbing Rope (Mountaineering)* — A mountaineering rope used for roping to each other two or more climbers, for the purpose of safety.

3.1.4 *Rappelling Rope (Mountaineering)* — A mountaineering rope used by climbers to come down from steep and vertical pitches.

3.1.5 *Single Rope* — Dynamic mountaineering rope, capable of being used singly, as a link in the safety chain, to arrest a leader's fall.

3.1.6 *Half Rope* — Dynamic mountaineering rope, which is capable, when used in pairs, as a link in the safety chain, to arrest the leader's fall.

3.1.7 *Twin Rope* — Dynamic mountaineering rope, which is capable, when used in pairs and parallel, as a link in the safety chain, to arrest a leader's fall.

NOTE — *See* Fig. 1 for examples of types of rope.

3.1.8 *Kernmantle Rope* — Braided climbing rope comprising of a braided sheath enclosing either a braided core or a core composed of parallel yarns.

NOTE — The resulting rope has a very high extension and energy absorption under load so that the falling climber is arrested at as low a deceleration as is possible, thus minimizing injury. The name is derived from the German 'Kern' meaning 'core', and 'Mantel' meaning 'sheath'.

3.1.9 *Low Stretch Kernmantle Rope* — A textile rope consisting of a core enclosed by a sheath, designed for use by persons in rope access including all kinds of work positioning and restraint; for rescue and speleology.

NOTE — The core is usually the main load bearing element and typically consists of parallel elements which have been drawn and turned together in single or several layers, or of braided elements. The sheath is generally braided and protects the core, for example from external abrasion and ultraviolet degradation.

3.1.10 *Braided Rope* — Rope in which a number of strands are plaited to form a core, and around which are plaited further strands to form a sheath. The core lies coaxially within the sheath.

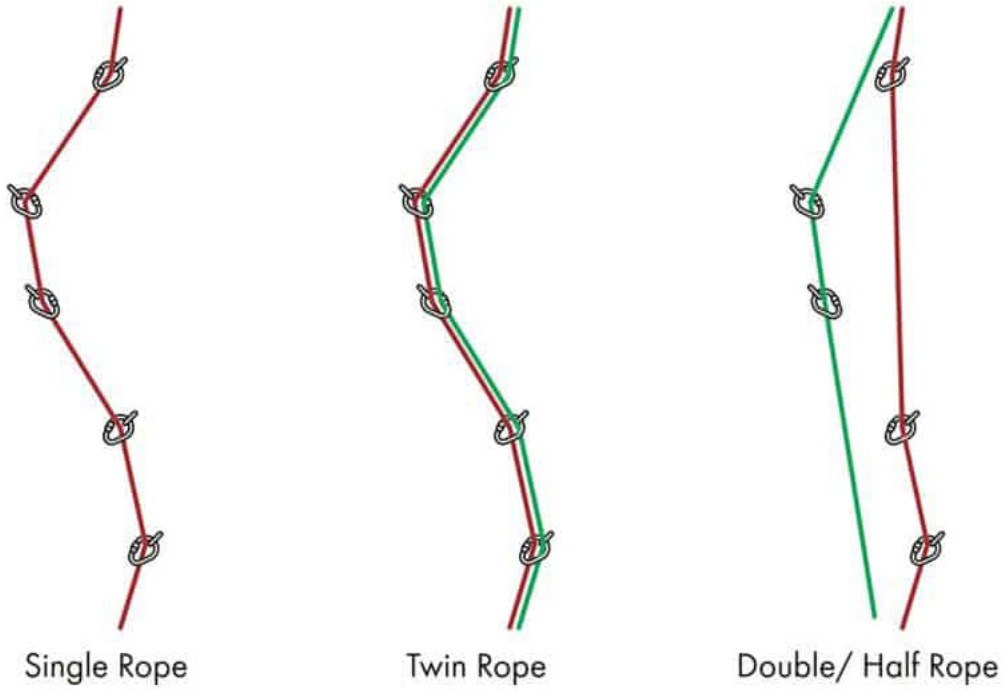

FIG. 1 TYPES OF DYNAMIC MOUNTAINEERING ROPE

3.2 Other Related Terms

3.2.1 *Core* — A textile product (yarn, strand small diameter rope, etc), placed generally along the axis of the rope and serving as a support for the strands.

3.2.2 *Lay* — The length of one complete turn or between two successive plaiting points of the same strand, measured parallel to the axis of the rope. The lay is expressed in millimetres (*see* Fig. 4).

3.2.3 *Kink* — Loop which forms in the rope as a result of excess turn being concentrated in a specific section within the length. It is generally due to over twisting or winding the cordage against the lay.

3.2.4 *Thimbled Eye* — Eye spliced into a rope which contains a thimble within it.

3.2.5 *Factor of Safety* — The factor by which the breaking load of the rope is divided to determine its safe working load.

3.2.6 *Safe Working Load* — The maximum load to which the rope may be subjected, it is a function of the fixed safety factor.

3.2.7 *Breaking Load (Breaking Strength)* — The maximum force which the rope (or cordage) is able to support during the tensile breaking test.

3.2.8 *Diameter (of Rope Under Tension)* — The diameter of the circle circumscribed about the cross section of the rope, measured under a given tension and by an accepted method.

3.2.9 *Tenacity* — Expression of stress related to mass, rather than the more usual relationship to cross-sectional area. It is determined by dividing the breaking strength of the material by its linear density to produce a value for the tenacity of the material in N/tex.

3.2.10 *Linear Density* — The mass per unit length. For ropes, the linear density is generally expressed in kilo tex (mass in kilograms per 1 000 m, or mass in grams per metre). It is measured under a tension defined for each type of rope.

3.2.11 *Rope Access* — The technique of using ropes, in combination with other devices, for getting to and from the place of work and for work positioning.

3.2.12 *Work Positioning* — A technique which enables a person to work supported in tension or suspension by personal protective equipment, in such a way that a fall is prevented.

3.2.13 *Safety Line* — High quality rope used for safety purposes by personnel engaged in dangerous work. *See* also ‘life line’.

4 DESIGNATION

The rope shall be designated by using abbreviations to represent different types of ropes used in mountaineering and Industry as given in Table 1.

Table 1 Sizes of Hands

(*Clause* 4)

A	Semi static ropes
B	Dynamic ropes
1	Single ropes
2	Half ropes
3	Twin ropes

For example, a single dynamic rope is designated as B1.

5 MANUFACTURE

5.1 Yarn

5.1.1 The yarn shall be a continuous virgin synthetic fibre. The materials used for the construction of the sheath and the core shall have a melting point greater than 195°C.

5.1.2 The yarns shall have a minimum tenacity of 67.5 g per tex (or 7.5 g per denier).

5.1.3 The yarns for the core should be doubled and twisted together.

5.1.4 The core and braiding should be well formed and free from knots, slubs or stains.

5.2 Rope

5.2.1 The braided rope should be tight. The rope should have uniform tension throughout its length. It should have uniform diameter with round cross-section and should be smooth to handle. It should be free from manufacturing flaws.

5.2.2 Each coil of the braided nylon rope shall be continuous throughout its length, and shall not contain any loose ends.

5.2.3 The extreme ends of the rope shall be heat-sealed.

5.2.4 If required, the rope may be dyed to the colour and shade as agreed to between the buyer and the seller.

6 REQUIREMENTS

6.1 Construction

The dynamic ropes and low stretch Kernmantle ropes shall be braided or double braided in construction. The constructional details of the rope, such as material, ends per spindle, ends in the sheath, ends in the core may be varied to suit the manufacturing conditions, provided the requirements given in Table 2 are met.

6.2 Sheath Slippage

6.2.1 In dynamic rope, the sheath slippage in a longitudinal direction relative to the core (in positive or negative direction) shall not exceed 1 percent (*see* Fig. 2 and Table 2).

6.2.2 In low stretch kernmantle rope, sheath slippage in a longitudinal direction relative to the core shall not exceed [20 mm + 10 (D-9 mm)] for ropes up to 12 mm diameter, and [20 mm + 5 (D-12 mm)] for ropes with a diameter between 12.10 mm and 16 mm, where D is the nominal diameter of the rope.

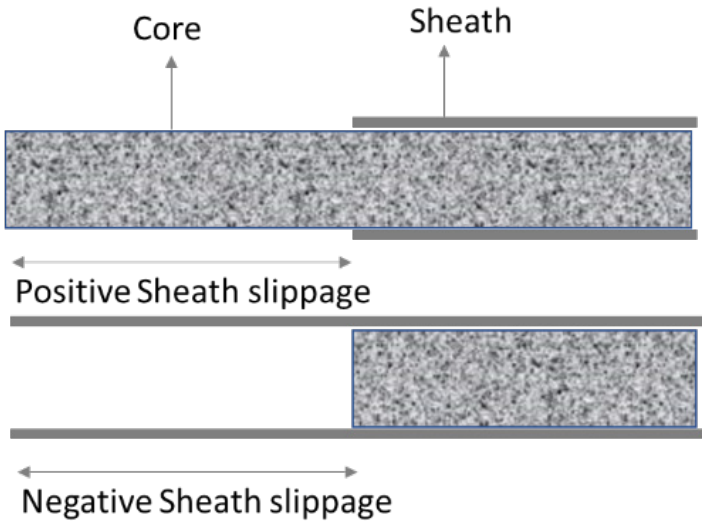

FIG. 2 POSITIVE AND NEGATIVE SHEATH SLIPPAGE

6.3 Static Elongation

When tested in accordance with **7.6** the static elongation for different categories of ropes shall not exceed:

a) 10 percent in single dynamic ropes (B1);
b) 12 percent in half dynamic ropes (B2);
c) 10 percent in twin dynamic ropes (B3); and
d) 5 percent in low stretch kernmantle rope (A).

6.4 Dynamic Elongation

When tested in accordance with **7.9** the dynamic elongation shall not exceed 40 percent during the first drop for each test sample of dynamic ropes.

Dynamic elongation test is not required in low stretch kernmantle ropes (*see* also Table 2).

6.5 Dynamic Strength

When tested in accordance with **7.7** the peak force in the rope, during the first drop, for each test sample, shall not exceed:

a) 12 kN in single ropes (single strand of rope);
b) 8 kN in half ropes (single strand of rope);
c) 12 kN in twin ropes (double strand of rope); and
d) 6 kN in low stretch Kernmantle ropes.

6.6 Dynamic Performance

When tested in accordance with **7.9** each rope sample shall withstand consecutive drop tests without breaking, the number of drops for different ropes shall be as follows:

a) 5 Drops in single ropes (single strand of rope);
b) 5 Drops in half ropes (single strand of rope);
c) 12 Drops in twin ropes (double strand of rope); and
d) 5 Drops in low stretch Kernmantle ropes.

6.7 Static Strength

The low stretch kernmantle rope without terminations shall sustain a force of at least 22 kN for a period of 3 min. The low stretch kernmantle rope with terminations shall sustain a static load of 15 kN for a period of 3 min (*see* also Table 2).

For dynamic ropes, static strength test is not required.

7 TEST METHODS

7.1 Test Samples

7.1.1 *Test Sample for Dynamic Ropes*

A test sample shall have a length of:

a) 40 m for single and half ropes; and
b) 80 m or 2 × 40 m for twin ropes.

The ropes should be identical to those that are placed on the market in every respect except for colour, for which there is no requirement.

7.1.2 *Test Sample for Low Stretch Kernmantle Ropes*

Test samples of low stretch kernmantle ropes of length 4 m, 3 m, and 2 m shall be used.

7.2 Conditioning

All the rope samples shall be conditioned in an atmosphere of less than 10 percent humidity for at least 24 h. The rope samples shall then be stored at a temperature of (20 ± 2)°C and a humidity of (50 ± 5) percent for at least 72 h. Tests shall be carried out at a temperature of (23 ± 5)°C.

7.3 Method for Measurement of Diameter and Mass per Unit Length

7.3.1 *Sample*

Take one unused rope of 3 000 mm length.

7.3.2 *Procedure*

Clamp the test sample at one end. Load the test sample without shock with a mass (or a corresponding force) of:

a) (10 ± 0.1) kg for single ropes;
b) (6 ± 0.1) kg for half ropes;
c) (5 ± 0.1) kg for twin ropes; and
d) (10 ± 0.1) kg for low stretch kernmantle ropes.

Apply the load for 60 s. Now mark the rope at a distance of at least 1 200 mm from the clamp. Within 10 s, again mark the rope at 1 000 ± 1 mm from the first mark.

Within next 3 min, measure the diameter in two directions around the cross-section, both at points 90° apart, at each of three levels approximately 100 mm apart. If the rope cross section is not circular, then the maximum and minimum diameter is to be determined in each section.

The length of the contact areas of the measuring instrument shall be (50 ± 1) mm. The rope cross-sectional area shall not be subject to any compression during the measurement.

Cut out the marked portion of the test sample and determine the mass to the nearest 0.1 g.

7.3.3 *Results*

Compute the diameter as the arithmetic mean of the six measurements to the nearest 0.1 mm.

Weigh the mass per unit length in nearest 1 g.

7.4 Length of Coil

Using appropriate data determine the length in metres, of a coil in the test sample by the following formula:

$$L = W/a$$

where

L = length of the coil, in metres;
W = conditioned mass of the coil, in grams (*see* **7.2**); and

a = conditioned mass of one metre length of rope (*see* **7.3**).

Determine similarly the length of each coil in the test sample.

7.5 Sheath Slippage

7.5.1 *Principle*

The rope is drawn through the apparatus illustrated in Fig. 3, the rope is exerted to a radial force where by creating friction between the sheath and the core, resulting in sheath slippage. The objective of the test is to measure the slippage in positive or negative direction.

7.5.2 *Preparation of the Test Samples*

An unused rope is fused from one end. At a length of 2 250 mm, an adhesive tape of 12 mm is applied to the rope. The adhesive tape should not be fully wound around the diameter of the rope. The angle of wrap should be between 150 to 180 degrees. Cut the rope with a sharp knife on the adhesive tape such that, the test rope has at least 10 mm adhesive tape at the end. The tape should be applied only half way around to view the sheath slippage at the end of the test and the tape should not interfere in the sheath slippage.

7.5.3 *Apparatus*

The apparatus shall be made of a frame of four circular steel plates each 10 mm thick, maintained at equal distances using three spacers. These spacers shall have rectangular slots in which three inserted rectangular steel plates are able to slide in a radial direction. The spacers shall be arranged in such a way as to allow each of the three inserted plates to slide at an angle of 120°.

Each of the seven plates shall have an opening with a diameter of 12 mm; their internal surfaces shall be semi toroidal and have a radius of 5 mm. The surface roughness shall be less than 4 µm (*see* Fig. 3).

The moving plates shall have a locked position in which the openings in the fixed plates and the openings in the moving plates all lie in line along a central axis. Each of the moving plates shall apply a radial force of (50 ± 0.5) N to the test sample in the direction in which the plate moves (by hanging test masses to the moving plates).

The test apparatus shall be shall be designed so that the rope slides through the plates in both directions (*see* Fig. 3).

7.5.4 *Procedure*

Insert the test rope in the apparatus such that at least 200 mm rope is visible at the other end. Ensure that the rope is straight. Apply a radial force of 50 N by hanging test masses on the moving plates.

Pull the test sample through the apparatus at a rate of (0.5 ± 0.2) m/s for a distance of 1 930 mm.

Now repeat the process in the reverse direction. Continue testing until the rope has passed through the test apparatus at least 4 times.

With the test sample still in the test apparatus, and the loads still applied to the moving plates, measure the relative slippage of the sheath along the core at the open end of the test sample.

7.5.5 *Results*

Calculate the sheath slippage in percentage of the sample length (2 000 mm). Express the value for each test sample to the nearest 0.1 percent.

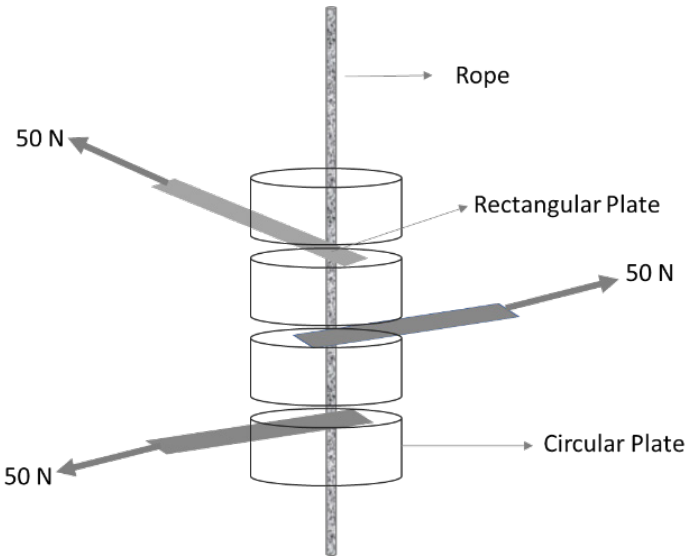

FIG. 3 SHEATH SLIPPAGE TEST RIG

7.6 Determination of Static Elongation

7.6.1 *Procedure for Dynamic Ropes*

Carry out the test on an unused rope of 3 000 mm of following configuration:

a) Single strand of rope for single ropes;
b) Single strand of rope for half ropes;
c) Double strand of rope for twin ropes; and
d) Low stretch Kernmantle ropes.

Clamp the test samples such that the free length between the clamps is 500 mm.

Load the test sample without shock within (10 ± 5) s with a mass of (5 ± 0.1) kg. After applying the load for 60 s, mark within the next 10 s a reference length of (1 000 ± 1) mm. Increase the load to (80 ± 0.1) kg without shock within (10 ± 5) s and maintain this load for (60 ± 5) s. Measure the new distance l_1 between the markings on the stressed test sample within the next 5 s.

7.6.2 *Procedure for Low Stretch Kernmantle Rope*

Clamp the test samples such that the free length between the clamps is 1500 mm.

Load the test sample without shock within 10 s with a mass of (5 ± 0.1) kg. After applying the load for 60 s, mark within the next 10s a reference length of (1 000 ± 1) mm. Increase the load to (150 ± 0.1) kg without shock within 10 s and maintain this load for (60 ± 5) s. Measure the new distance l_1 between the markings on the stressed test sample within the next 5 s.

7.6.3 *Results*

Compute the elongation as a percentage of the unloaded length: that is (l_1 – 1 000)/10. Express the results to the nearest 0.1 percent for each test sample.

7.7 Dynamic Strength Tests

7.7.1 *Apparatus*

The mass used for dynamic strength tests shall weigh (100 ± 1) kg. If the mass is guided, the speed measured shall be within 2 percent of the speed attained when an object is under free fall.

7.7.2 *Sample*

If the ropes are placed on the market with termination than the sample of rope shall be terminated at least one end otherwise a figure of 8 knot is made at each end**.**

The length of the rope shall be such that when the mass is hanging freely (before the first drop) from the anchor point, its distance shall be 2 000 ± 10 mm

7.7.3 *Peak Fall Arrest force*

a) Suspend the 100 kg mass to one end of the rope. Connect the other end of the rope to an anchor point along with a peak force measuring instrument as described in **6.1.4** of IS 3521 (Part 6) from the anchor point.
b) Lower the mass until the rope is in stretched condition.
c) Raise the mass by 600 ± 20 mm and hold it by a quick release device as per **6.1.3** of IS 3521 (Part 6). The mass shall be at a maximum of 100 mm horizontally from the test structure.
d) Activate the quick release device and allow the mass to fall.
e) Measure the peak force.

7.7.4 *Dynamic Strength Test for Low Stretch Kernmantle Rope*

a) Raise the 100 kg mass so that the attachment point of the mass is at the same height as the anchorage point on the rigid structure, at a maximum of 100 mm horizontally from it (*see* Fig. 4). Hold the mass by the quick release device.
b) Activate the quick release device and allow the mass to fall.
c) After the drop release the load from the low stretch kernmantle rope within 1 min.
d) Repeat a) to c) for the next drop. The interval between the consecutive tests on the rope sample shall be (3 ± 0.5) min from release to release.
e) Carry out the tests on the rope sample according to the requirements listed in Table 2.

7.8 Static Strength Test

7.8.1 *Apparatus*

7.8.1.1 Static strength testing apparatus, consisting of a test frame, winch or hydraulic puller and indicator, with sufficient traverse to load the rope. The stroke and bed length should be long enough to extend the specimen. Different types of tensile testing machines may be used:

a) bollard-type grip testing machine;
b) testing machine with pins for eye splices; and
c) Wedge-grip testing machine.

7.8.1.2 In the case of a bollard-type tensile testing machine, the diameter of the bollard or capstan holding down the test pieces shall be equal to at least 10 times that of the rope being tested.

7.8.1.3 In the case of a testing machine with pins, the diameter of the pins passing through the eye-spliced

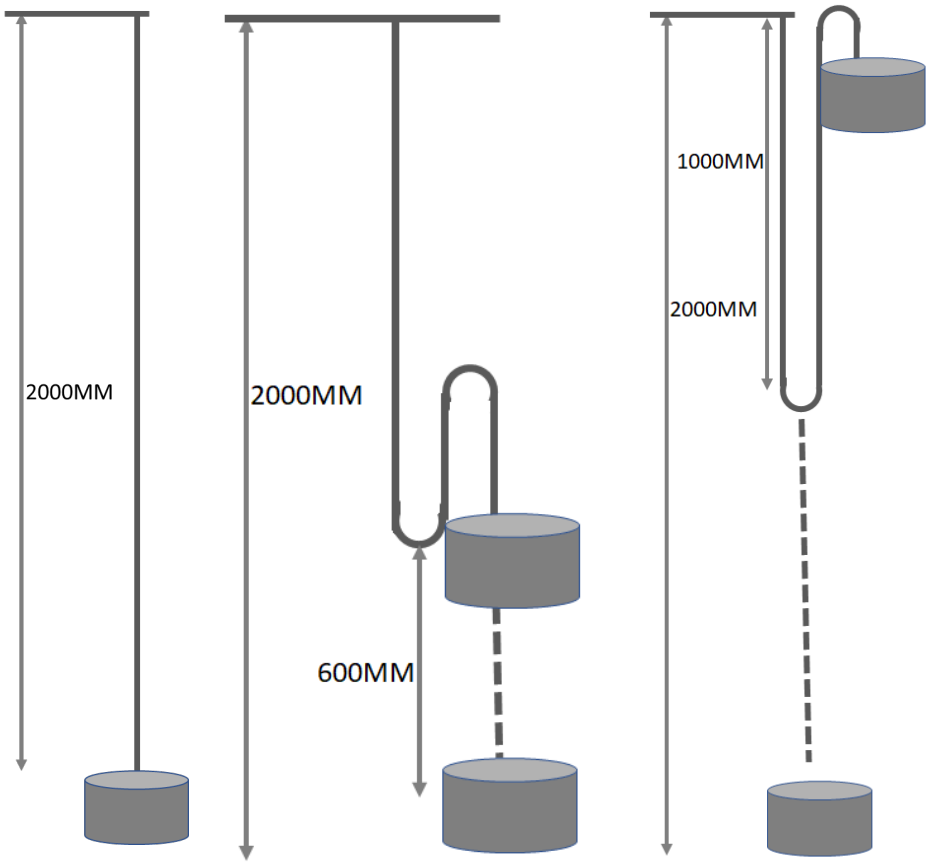

FIG. 4 DYNAMIC STRENGTH TEST FOR LOW STRETCH KERNMANTLE ROPE

test pieces shall be of an adequate size so that the rope does not break in the eye, in principle at least twice the diameter of the rope being tested. Force measuring requirement shall be in accordance with **6.1.4** of IS 3521 (Part 6).

Requirements for the rate of stressing shall be 250 mm/min ± 50 mm/min, in accordance with **9.5** of IS 7071 : 2021.

7.8.2 *Sample*

Two unused rope sample of minimum length 3 000 mm shall be used for the test. One sample shall be terminated at both ends in loops produced by tying figure of eight knots. The minimum rope length between the attachment points of the test machine, excluding terminations, shall be 300 mm before any load is applied. Visually check that the knots on the termination loops are symmetrical and that the ropes lie parallel in the knot, and hand tighten equally. The second sample should be without a knot at either end.

7.8.3 *Procedure for Ropes with Termination*

a) Install the sample with loops, in the test machine;
b) Apply the specified force on the sample as per Table 2 for ropes with termination; and
c) Observe that the sample withstands the force for a period of 3 min.

7.8.4 *Procedure for Ropes without Termination*

a) Install the sample without knots on wedge grip/bollard grip in the test machine.
b) Apply the specified force on the sample as per Table 2 for ropes without termination.
c) Observe that the sample withstands the force for a period of 3 min.

7.9 Dynamic Performance Test/Drop Test for Determination of Peak Force, Dynamic Elongation, and Number of Drops

7.9.1 *Dynamic Performance Test/Drop Test for Dynamic Ropes*

Carry out the first drop test within 10 min of the respective test sample's removal from the conditioning atmosphere.

7.9.1.1 *Drop test apparatus*

The drop test apparatus simulates a fall and abrasion generated in the rope in the process of fall. The test equipment shall consist of the following:

a) End anchor;
b) Orifice plate;
c) Falling mass and guidance rails;
d) Peak load measuring instrument;
e) Peak extension measuring instrument of the rope; and
f) Descent timing measurement instrument of the mass to check that the guidance rails do not slow down the free fall of the mass.

Fig. 5 shows the drawing of a typical test rig.

7.9.1.2 *End anchor*

One end of the rope is terminated in a figure of eight knot (*see* Fig. 5). The knot is connected to a fixed anchor eye using a carabiner. IS 8533 may be referred for carabiners.

7.9.1.3 *Orifice plate*

The orifice plate shall be manufactured from 10 mm thick steel plate with surface hardness of at least 52 HRC. There shall be a cylindrical hole machined through the orifice plate at right angles to its surface. The inside edge of the orifice shall be in 'U' shape. The surface of the orifice which would be in the contact of the rope shall have a roughness less than 4 µm.

7.9.1.4 *Falling mass and guidance rails*

The falling mass shall be guided through two vertical guide rails. The orifice plate shall be at right angles to the orientation of guide rails.

The falling mass shall fall freely, with minimum contact with the guide rail. The mass may however come in to contact with the guide rail once the rope is under tension during the fall. To reduce friction ball bearings may be used.

The falling mass shall be fitted with an eye to attach the rope. The position of the eye should be such, that during the free fall, the falling mass has minimum contact with the guide rails.

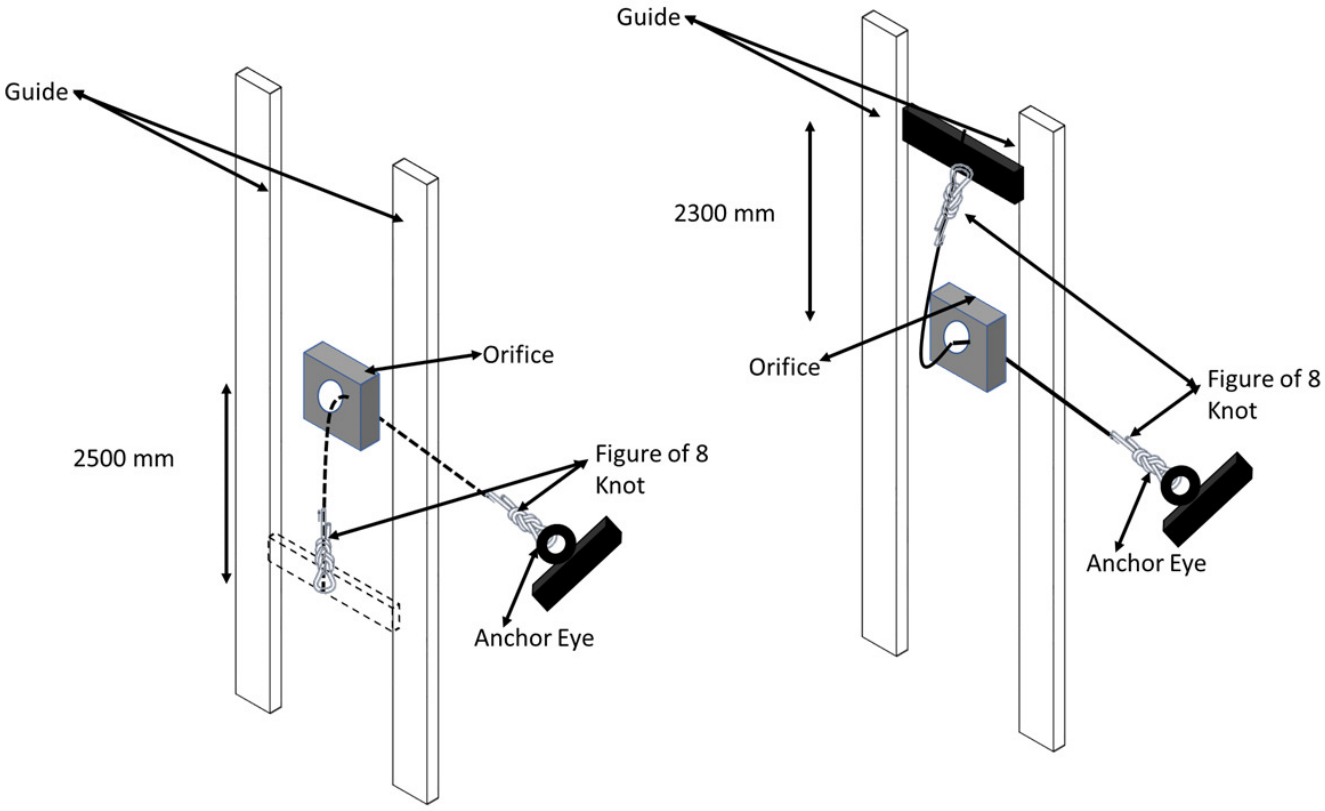

FIG. 5 DROP TEST APPARATUS

The weight of the falling mass (along with eye and guide bearings) shall be as follows.

a) 80 ± 0.1 Kg for single ropes;
b) 55 ± 0.1 Kg for half ropes;
c) 80 ± 0.1 Kg for twin ropes; and
d) 100 ± 0.1 Kg for low stretch kernmantle ropes.

The apparatus for measuring and recording the force in the rope shall correspond with **5.1.6** and **5.1.7** of IS 3521 (Part 2).

7.9.1.5 *Test setup and calibration of test rig*

a) *Measure peak extension of the rope* — Allow the mass to hang freely on the test rope. The mass should be 2 500 mm below the orifice. This point is marked as a reference point for measurement of the extension. The extension is measured from this reference point
b) *Measure timing of descent of the falling mass* — Measure the timing between two reference points which are one meter apart during the free fall of the test mass. Repeat the test two times selecting different reference point.
c) *Strength of apparatus* — Connect a rope with a figure of 8 knot to the anchor point. Pass it through the orifice. Apply a static force of 24 kN (Maximum dynamic force anticipated as 12 kN hence structure tested to a safety factor of two). The deflection in the orifice plate shall not be greater than 2 mm.
d) *Calibration of the apparatus* — Repeat the tests at least once annually to measure the timing of the falling mass. The time to travel 1 m should be 100 ± 2 ms.

7.9.1.6 *Procedure*

a) Connect the test ropes to the anchor point using a figure of eight knot.
b) Pass the test rope through the orifice.
c) Connect the other end of the rope to the attachment point of the test mass with a figure of 8 knot.
d) Load the test rope with the mass and maintain the load for 60 s. For twin ropes ensure that the tension in both the ropes is similar.
e) Raise the falling mass to a height 2 300 ± 50 mm above the lowest point of the orifice.
f) Release the falling mass using a quick release clamp.
g) Measure the peak force generated.
h) Measure the maximum extension of the test rope achieved.
j) Within a period of 5 min repeat the drop.
k) Measure the time of drop between two reference points one meter apart. The time should be 120 ms ± 5 ms. Repeat the test if the time measured is incorrect. Check the equipment for friction with the guide rails if the time measured is outside the limits.
m) After each drop, remove the load from the rope(s) within 60 s.
n) Continue the drop tests until the rope breaks. Record the number of drops before the rope breaks.

7.9.1.7 *Results*

a) Record Peak force in kN.
b) Record the dynamic elongation in the rope as a percentage of elongation compared to the original length of the rope.
c) Record number of drops before the test rope breaks.

7.9.2 *Dynamic Performance Test for Low Stretch Kernmantle Ropes*

a) The same drop test apparatus as described in **7.9.1** is to be used for low stretch kernmantle ropes. On top edge of the guide rails, an anchor eye is installed. The anchor eye is in between the two guide rails.
b) The mass used for this test is 100 kgs, with an anchor eye to connect it to the test rope.
c) Connect a test rope of 4 000 mm length using a 'figure of eight' knot to an anchor eye installed on the top of the test rig.
d) Suspend the 100 kg mass on the other end of the rope by tying a figure of eight knot to the anchor eye of the mass. Hold the load for 60 s.
e) Raise the mass to 600 mm and release the mass using a quick release clamp. Ensure that the mass is within 100 mm horizontally from the vertical plane of the test rope. Record the peak force.
f) Repeat the tests 5 times.

7.10 Knotability 'K'

a) Create two knots 250 mm apart and in opposite direction in a test rope of 3 000 mm length. Attach one end of the rope to an anchor eye. Hang a mass of 10 kg on the other end of the rope gently avoiding any shock. Maintain the load for 60 s.
b) Now reduce the load slowly to 1 kg. With a conical gauge (*see* Fig. 6) measure the internal diameter of each knot.
c) Results — calculate the average of the internal diameters of both knots.

Knotability 'K' = average internal diameter of the knots/rope diameter.

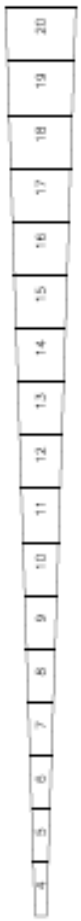

FIG. 6 CONICAL GAUGE

7.11 Shrinkage 'R'

a) Suspend a test rope of 1 500 mm. Attach one end of the rope to an anchor eye. Hang a mass of 10 kg on the other end of the rope gently, avoiding any shock. Maintain the load for 60 s.

b) With a marker, mark the rope at two places 1 m apart.

c) Remove the rope from the test fixture and submerge the rope in a tank of water for a period of 24 h. Ensure that both ends of the rope are heat sealed before submerging in the water.

d) Within 15 min of removal from the water tank, suspend the rope again and apply the mass of 10 kg gently. Hold the load for 60 s. Measure the distance between the two marks.

e) Compute in percentage the reduction of the distance between the two marks, before and after submerging in water. This is denoted as Shrinkage 'R'.

8 SEALED SAMPLE

8.1 If, in order to illustrate the pattern and workmanship of the rope, a sample has been agreed upon and sealed, the supply shall be in conformity with the sample in such respects.

8.2 The custody of the sealed sample shall be a matter of prior agreement between the buyer and the seller.

9 MARKING

9.1 Marking on label

Each coil of rope in a lot shall be marked with the following:

a) Name (for example braided nylon rope for mountaineering or high altitude operation);

b) Designation number;

c) Shrinkage;

d) Knotability;

e) Runnage;

f) Manufacturer's name, initials or trade mark;

g) Length of rope; and

h) Year of manufacture.

NOTE — The above information may be given on a strong cloth label attached to the coil.

10 BIS CERTIFICATION MARKING

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

11 PACKAGING

Coils of rope shall be packed in accordance with the method prescribed in IS 3256 or as agreed to between the buyer and the seller.

Table 2 Test Requirements

(*Clauses* 6.1, 6.2.1, 6.4, 6.7, 7.7.4, 7.8.3 *and* 7.8.4)

Types of Rope	Sheath Slippage	Static Elongation	Dynamic Elongation	Dynamic Strength	Dynamic Performance	Static Strength	
						with termination	without termination
Requirement Clause	6.2	6.3	6.4	6.5	6.6	6.7	6.7
Test Method Clause	7.5	7.6	7.9	7.7	7.9	7.8	7.8
Low Stretch Kernmantle Rope	upto 12 mm dia — 20 mm + 10 (D-9) mm 12 mm to 16 mm dia — 20 mm + 5 (D-12) mm	5 percent	NA	6 kN	5 drops	15 kN	22 kN
Single Rope	Shall not exceed 1 percent	10 percent	40 percent	12 kN	5 drops	15 kN	22 kN
Half Rope	Shall not exceed 1 percent	12 percent	40 percent	8 kN	5 drops	15 kN	22 kN
Twin Rope	Shall not exceed 1 percent	10 percent	40 percent	12 kN	12 drops	15 kN	22 kN

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Mountaineering and Adventure Sports Sectional Committee, PGD 27

Organization	*Representative(s)*
Indian Mountaineering Foundation, New Delhi	Wg Cdr Amit Chowdhury (***Chairman***)
Atal Bihari Vajpayee Institute of Mountaineering and Allied Sports, Manali	Director
Border Security Force, New Delhi	Shri Prem Vishwas IG Training (*Alternate*)
Defence Materials and Stores Research and Development Establishment, Kanpur	Director
Defence Metallurgical Research Laboratory, Ministry of Defence, Hyderabad	Dr T. Raghu Mr Venkata Ramana (*Alternate*)
Defence Research Development Organization, Ministry of Defence, New Delhi	Shri R. Shankar
Defense Research and Development Organization, Snow and Avalanche Study Establishment, Chandigarh	Director
Directorate General of Quality Assurance, Ministry of Defence, New Delhi	M. Satyanarayana Shri M. V. Kumbhalkar (*Alternate*)
Garware Technical Fibres Ltd, Pune	Satish J. Chitnis
Gipfel Climbing Private Ltd, Meerut	Apar Mahajan
High Altitude Warfare School, Gulmarg, J & K	The Commandant
Himalayan Mountaineering Institute, Darjeeling	Gp Capt Jaikishan Capt Mohamed Fasith (*Alternate*)
Indian Mountaineering Foundation, New Delhi	Shri Harish Joshi Sudhir Krishnankutty (*Alternate*)
Indo Tibetan Border Police, New Delhi	The Commandant
Jawahar Institute of Mountaineering and Winter Sports, Pahalgam	Principal
Karam Industries, Noida	Shri Z. A. Mohammad Shri Sanjiv Sharma (*Alternate*)
Kohinoor Ropes Pvt Ltd, Aurangabad	Sunil Bihani Vinay Chandak (*Alternate*)
Master General Ordnance Branch, New Delhi	CEO
Motilal Dulichand Private Limited, Kanpur	Shri Shailendra Misra Shri Sunil Prahladka (*Alternate*)
Mountaineering and Skiing Institute (M & SI), Auli	Brig Yashpal Singh (Retd) Balwinder Singh (*Alternate*)
National Test House, Kolkata	Avinash Kumar
Nehru Institute of Mountaineering, Uttarkashi	Principal

Organization	*Representative(s)*
Northern India Textile Research Association, Ghaziabad	Shrimati Neha Kapil Dr M. S. Parmar (*Alternate*)
Outdoor School, New Delhi	Shri Mohit Oberoi
R K Enterprises, Faridabad	Shri Lalit Nagpal Shri Raja Ram Prasad (*Alternate*)
Safety Appliances Manufacturer's Association, Mumbai	Shri Natwar Bagri Avneet Antoorkar (*Alternate*)
Sagar Asia Pvt Ltd, Secunderabad	Miss T. Anitha Prasad
Sonam Gyatso Mountaineering Institute, Gangtok	Principal
Swami Vivekanand Institute of Mountaineering, Mount Abu	Principal
Thanawala and Company, Mumbai	Shri Hemal M. Thanawala
The Synthetic and Art Silk Mills Research Association, Mumbai	Dr Manisha Mathur Shrimati A. Sudam (*Alternate*)
Trekko Equipment, New Delhi	Shri Nagesh Sethi
In Personal Capacity	Col H. S. Chauhan
In Personal Capacity	Col A. B. Goth
In Personal Capacity	Brig K. Kumar
BIS Director General	Shri Navindra Gautam, Scientist 'E' and Head (PGD) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Kundan Giri
Scientist 'C' (PGD), BIS

Panel on Mountaineering Ropes, PGD 27/P1

Organization	*Representative(s)*
Karam Industries	Shri Z. A. Mohammad (***Convener***)
Bureau of Indian Standards, New Delhi	Shri Kundan Giri
DMRL, Hyderabad	Dr T. Raghu
Motilal Dulichand Private Limited, Kanpur	Shri Shailendra Misra
National Test House, Ghaziabad	Shri Avinash Kumar
RK enterprises, Faridabad	Dr Balraj Gupta
Safety Appliances Manufacturer's Association, Mumbai	Shri Natwar Bagri
Thanawala and Co	Shri H. M. Thanawala
The Synthetic and Art Silk Mills Research Association, Mumbai	Dr Manisha Mathur
Wool Research Association, Thane	Miss Seema Patel

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower-1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
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